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Social norm nudges in shopping trolleys to promote vegetable purchases: A quasi-experimental study in a supermarket in a deprived urban area in the Netherlands

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ABSTRACT

Background: Supermarkets are a key point of purchase for groceries and can therefore have a considerable influence on eating behaviours. Evidence suggests that descriptive social norm nudges in shopping trolleys can be effective in stimulating vegetable purchases in supermarkets.
Objective: We investigated the effect of a combination of two nudging strategies in shopping trolleys – a social norm about vegetable purchases and a designated place to put vegetables – on the amount of vegetables purchased in a supermarket in a deprived urban area in the Netherlands.
Design: A quasi-experimental study was conducted with two conditions: 1) intervention days on which the shopping trolleys in the supermarket had a green nudge inlay indicating a place for vegetables and a social norm message and 2) control days on which the regular shopping trolleys (no inlay or social norm) were used in the supermarket. During both the intervention and control days, vegetable purchases were measured by means of the cash receipts collected from customers at the checkouts. In addition, individual and purchase characteristics were assessed by means of short surveys.
Results: In total, 244 customers participated in the study. Ordinal logistic regression analyses showed that customers on the intervention days (n = 123) were in a higher tertile for grams of vegetables purchased compared to the customers on the control days (OR: 1.66, 95% CI: 1.03–2.69, p = 0.03), especially those who bought groceries for less than three days (OR: 3.24, 95% CI: 1.43–7.35, p = 0.003). Sensitivity analyses also showed that intervention customers who noticed the green inlay were even more likely to purchase more vegetables (OR: 1.86, 95% CI: 1.06–3.25, p = 0.02).
Conclusions: This quasi-experimental study showed that a nudge inlay in shopping trolleys communicating a social norm on vegetable purchases and indicating a distinct place to put vegetables in the trolley increased vegetable purchases among supermarket customers.

1. Introduction

Inadequate vegetable consumption is of considerable public health concern. A diet low in vegetables is associated with an increased risk of overweight and obesity, as well as chronic diseases such as type 2 diabetes, cardiovascular disease and certain types of cancers (Boeing et al., 2012; Key, 2011; Sotos-Prieto et al., 2017). Most people do not meet the recommended daily intake of vegetables. In the Netherlands, only 6% of people aged between 1 and 79 years consume the recommended daily amount of 250 g of vegetables (Van Rossum et al., 2016). Therefore, the need for effective interventions supporting people to increase their vegetable intake is urgent.

Although there are many factors that contribute to unhealthy diets, the food environment is considered to have a significant influence on eating behaviours (Glanz, Sallis, Saelens, & Frank, 2005; Swinburn et al., 2011). Supermarkets represent key food environments because in many affluent societies they are the primary source of people's food purchases (Hawkes, 2008; Ni Mhurchu et al., 2013), with 77% of food

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purchases in the Netherlands being made in supermarkets (Spending and market share; Detailhandel, 2010). Therefore, supermarkets can have a considerable impact on people's food choices. Systematic reviews have demonstrated the potential of supermarket interventions to promote healthy food purchases such as vegetables (Adam & Jensen, 2016; Cameron, Charlton, Ngan, & Sacks, 2016; Escaron, Meinen, Nitzke, & Martinez-Donate, 2013).

A promising strategy to stimulate vegetable purchases in supermarkets is nudging. This has been defined as 'any aspect of the choice architecture that alters people's behaviour in a predictable way, without forbidding any options or significantly changing their economic incentives' (Thaler & Sunstein, 2008). For example, one study showed that increasing the availability of vegetables, among other items, at the checkout counter in supermarkets in Denmark led to increased sales of vegetables (Winkler et al., 2016). Evidence also suggests that descriptive social norms that explain the behaviours of similar others can serve as a nudge encouraging vegetable purchases (Bucher et al., 2016; Cialdini & Trost, 1998). People have the tendency to want to belong to a group and they perceive behaviours of similar others as the norm (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Communicating information about what and how many vegetables are appropriate or normally purchased by other customers may be effective in the promotion of vegetable purchases in supermarkets. For example, a prior study by Payne and colleagues showed that social norm messages about the fruit and vegetable purchases of other customers that were displayed in shopping trolleys increased the sales of fruit and vegetables in supermarkets in the United States (Payne, Niculescu, Just, & Kelly, 2015). Moreover, cues in the supermarket which suggest that it is 'normal' to purchase vegetables can also increase the sales of vegetables. In addition, a recent study by Wansink and colleagues showed that dividing shopping trolleys into two parts by means of a paper mat on the physical bottom, of which one part was reserved for 'fruit and vegetables', increased the sales of fruit and vegetables in a supermarket in Canada (Wansink, Soman, & Herbst, 2017). However, to the best of our knowledge, these previous studies were conducted in supermarkets in neighbourhoods with a middle or high socioeconomic position (SEP), whereas it seems especially important to promote vegetable purchases among people from low-SEP groups, since they have a lower vegetable intake compared to people from higher SEP groups (Gallo et al., 2012; Giskes, Turrell, Van Lenthe, Brug, & Mackenbach, 2006). Furthermore, these previous studies used the amount of money spent on fruit and vegetables as an outcome measure, so it is not clear whether the customers purchased a larger amount of fruit and vegetables or whether they purchased fruit and vegetables that were more expensive.

The aim of this quasi-experimental study was to investigate the effect of a combination of two single nudges in shopping trolleys – a social norm message about vegetable purchases and a designated place to put vegetables – on the amount of vegetables purchased in a supermarket in a deprived urban area in the Netherlands.

2. Methods

2.1. Context and design

This study was conducted as part of a collaboration between the Amsterdam Healthy Weight Programme (Amsterdam), the Amsterdam Health & Technology Institute (AHTI), Albert Heijn (the supermarket chain with the largest market share in the Netherlands) and Vrije Universiteit Amsterdam in the Netherlands. The overall aim of this collaboration is to create a healthier food environment for children and their parents in deprived neighbourhoods in Amsterdam and to study the effectiveness of these efforts. Compared with other districts in the Netherlands, these neighbourhoods are characterized by inhabitants with a lower SEP and have higher rates of overweight and obesity.

In the current study, we used a quasi-experimental design with two conditions in one supermarket: 1) intervention days on which the shopping trolleys in the supermarket had a green nudge inlay and social norm message and 2) control days on which the regular shopping trolleys (no inlay or message) were used in the supermarket. Data collection took place on Friday between 6 p.m. and 10 p.m. and Saturday between 10 a.m. and 2 p.m. during a two-week time period in the second and third weeks of May 2017. These days and time slots were chosen because we assumed that it was the time that the majority of weekly groceries were purchased. This assumption was based on information about the most popular shopping times in the week provided by the manager of the participating supermarket. In the first week, the intervention day was Friday and the control day Saturday. In the second week, the intervention day was Saturday and the control day Friday. During the data collection, all customers received a cash receipt by default after they had paid.

The study was conducted according to the ethical standards of the Helsinki declaration of 1975, as revised in 2000. Active verbal informed consent was given by all customers. This trial was registered at the ISRCTN (ISRCTN39440735), and the Medical Ethics Committee of Vrije Universiteit Amsterdam confirmed that this study does not fall under the Medical Research Involving Human Subjects Act (WMO), due to the nature of the measurements (sales data and anonymous questionnaires distributed among adults) and therefore its approval was waived.

2.2. Supermarket selection

The collaborating supermarket chain selected one supermarket in a deprived area in Amsterdam, the Netherlands. This area was selected based on the Valuation of Immovable Property Act (VIPA), which is estimated annually (WOZ). This Act establishes how municipalities are to assess the value of homes and businesses within specific neighbourhoods, which is strongly associated with the average SEP of the inhabitants of those neighbourhoods. We defined a neighbourhood with low or very low VIPA scores as deprived. To recruit the supermarket, the store manager of the supermarket was contacted by phone and informed about the study, while their participation was requested by an employee from headquarters. After the store manager agreed to participate, the supermarket was visited to become acquainted with the store and the manager, while practical information about the study was provided by the employee from the head office and a researcher.

2.3. Intervention description

In the current study, we combined two single nudging strategies in shopping trolleys, which were intended to increase vegetable purchases. These strategies were based on those of Wansink and colleagues and Payne and colleagues (Payne et al., 2015; Wansink et al., 2017). We wished to determine whether a green inlay in shopping trolleys that covered half of the bottom of a trolley, indicating a space where customers could place their vegetables, combined with social norm messages about vegetable purchases of other customers of the supermarket, increased the sales of vegetables. The intervention in this study consisted of three green inlays (475 × 385 mm by 427 × 330 mm) that covered half of the physical bottom of a trolley, each with a different social norm message about vegetable purchases by other customers from the participating supermarket (Fig. 1). The social norm messages were shown on the inside front of the trolleys, so customers were facing the message as they pushed their trolley while shopping. Previous research on social norm communication was used to develop the social norm messages (Cialdini, Reno, & Kallgren, 1990). In addition, data on the sales of vegetables by the participating supermarket provided us with information about which vegetables were most often purchased. To ensure that the messages were easy to interpret, nine messages were piloted among 23 customers of the participating supermarket by two research assistants. During this pilot, two different messages at a time were shown to the customers and they were asked to choose their favourite. Subsequently, their most favourite message and a new message

Fig. 1. Shopping trolley with a green inlay with one of the three social norm messages 'The three most popular vegetables in this supermarket are 1) cucumber, 2) avocado and 3) bell pepper'. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

were shown together and they were asked to decide again, until there was one favourite message left. The three most favourite messages resulting from the pilot were used in the main study. They were: 1) 'The three most popular vegetables in this supermarket are cucumber, avocado and bell pepper,' 2) 'Most customers pick at least seven vegetables' and 3) Asha, mother of two children: 'I frequently give my children vegetables as a snack, for instance, small tomatoes, bell peppers or carrots'. Graphics of vegetables were included on the green inlays to visualize the messages. On the intervention days, the three different inlays were randomly divided across the trolleys and inserted by the research team with the assistance of a supermarket employee an hour before measurements took place.

2.4. Participants and procedure

During the data collection, a total of 365 supermarket customers with a shopping trolley and a cash receipt were asked to participate in a study about purchase behaviours after they had paid for their groceries, of which 257 customers were willing to participate (response rate 58%). The main reasons for not participating in the study were a 'lack of time' and 'already participated in the study last week'. If customers agreed to participate, the researchers asked several survey questions, which took on average three minutes. Subsequently, the researcher took a picture of the customer's cash receipt. Six customers who did not want the researcher to take a picture of their cash receipt were not included in the study. Customers who purchased groceries for more than twelve people for only one day were also not included in the study because we assumed that the numbers were different from their usual weekly purchases (e.g. people who were having a party, N = 7). In total, the cash receipt data of 244 customers were included in the analyses of this study.

2.5. Measures

Questionnaire. The questionnaire consisted of eleven questions. Customers were asked to indicate: for how many days they had purchased their groceries (1–7 days); for how many people they had purchased their groceries (open answer); and whether they used a shopping list (No – Yes – I don't know). Subsequently, customers were asked where they most often purchased vegetables (participating supermarket, another supermarket, greengrocer, market, somewhere else) and if they thought that they had purchased fewer/more/just as many vegetables during this shopping trip as they usually do in this supermarket (Fewer – More – Just as many – I don't know). Finally, demographic questions were asked, including sex (man/woman), age category (youth, below 18; adult, 18–55; elderly 55+) and highest level of education obtained (I don't know/won't say, primary school, basic vocational education, secondary vocational education, secondary school degree, higher vocational education, university). For the analyses, the response options for education level were combined into three categories (low educational level, medium educational level, high educational level). On the intervention days, customers were also asked if they had noticed anything in their shopping trolley (No – Yes – I don't know), and if so, what they had noticed (open answer).

2.5.1. Cash receipts

Vegetable purchases (measured by the number of grams and in items) were assessed based on the customers' supermarket receipts. This method has been previously validated and found to be an effective measure of household food purchases (French, Wall, Mitchell, Shimotsu, & Welsh, 2009). Vegetables purchased included single vegetables and multi-packed fresh, sliced and diced, or frozen vegetable items, as well as prepacked meals that contained vegetables. Grams of vegetables was determined by calculating the total number of vegetables purchased. Vegetable items were determined by measuring each vegetable product as an 'item'. We used this outcome measure because we were interested in the question of whether nudging would increase the selection of vegetable items per purchase.

2.6. Statistical analyses

We used descriptive statistics to summarize customer and grocery behaviour characteristics. We considered the number of grams of vegetables purchased and the number of items of vegetables purchased as dependent variables, while the condition (control day vs intervention day) was the independent variable. We tested for the normality of distribution by conducting the Test for Normality (Kolmogorov-Smirnov) in SPSS, and examined histograms and boxplots for the number of items and grams separately. The data were very skewed and transformations (using multiple options) did not improve this sufficiently ($p < 0.000$). As the cash receipts data were not normally distributed, medians for the number of vegetables purchased (in grams and items) were calculated. Moreover, ordered discrete categories for the number of vegetables purchased were calculated using tertiles, indicating the lowest, middle and highest number of vegetables purchased (Table 3).

Ordinal logistic regression analyses were used to investigate the association between condition and vegetables purchased (low, mid and high numbers purchased), for the number of grams and items separately (Ananth & Kleinbaum, 1997). The proportional odds assumption was investigated using the test of parallel lines. No assumptions were violated. We considered sex, age category, highest level of education obtained and the number of people for whom groceries were purchased as potential confounders. The variable related to the number of people for whom groceries were purchased was dichotomized, comparing customers who purchased groceries for less than three people to customers who purchased groceries for three or more people (the cut-off point was based on the median).

Table 1
Characteristics of the study sample for the total study period and for the control and intervention days separately.

	Total study period	Control days	Intervention days
n	244	121	123
Sex, *n* (%)			
Women	149 (61.1)	68 (57.1)	81 (66.4)
Age (category), *n* (%)			
18-55	125 (51.2)	60 (49.6)	65 (52.8)
55 +	115 (47.1)	59 (48.8)	56 (45.5
Missing	4 (1.6)	2 (1.7)	2 (1.6)
Education level[a], *n* (%)			
I Don't know/no answer	26 (10.7)	18 (14.9)	8 (6.5)
Low	31 (12.7)	13 (10.7)	18 (14.6)
Medium	70 (28.7)	30 (24.8)	40 (32.5)
High	116 (47.5)	59 (48.8)	57 (46.3)
Missing	1 (0.4)	1 (0.8)	

[a] Low = primary education, lower secondary education; Medium = vocational education, higher secondary education; High = college, university.

Table 2
The number of purchased vegetables per customer (in items and grams) and grocery behavior characteristics for the total study period and for the control and intervention days separately.

	Total study period	Control days	Intervention days
n	244	121	123
Number of purchased vegetable items[b]	3.00 [0, 17]	2.00 [0, 15]	3.00 [0, 17]
Number of purchased vegetable grams[b]	1040 [0, 7161]	900 [0, 6785]	1120 [0, 7161]
Number of days for which groceries were purchased[c]	3.62 (2.20)	3.74 (2.30)	3.51 (2.09)
Number of persons for which groceries were purchased[c]	2.77 (1.43)	2.80 (1.62)	2.73 (1.23)
Use of a grocery list, *n* (%)			
Yes	132 (54.1)	67 (55.4)	65 (52.8)
Place where vegetables are purchased most often[a], *n* (%)			
Study supermarket	169 (69.3)	81 (66.9)	88 (71.5)
Other supermarket	52 (21.3)	20 (16.5)	32 (26)
Greengrocer	8 (3.3)	6 (5.0)	2 (1.6)
Marketplace	33 (13.5)	15 (12.4)	18 (14.6)
Other	6 (2.5)	6 (5.0)	0 (0)
Perceived number of purchased vegetables compared to those purchased usually, *n* (%)			
Less	109 (44.7)	55 (45.8)	54 (43.9)
More	22 (9.0)	7 (5.8)	15 (12.2)
Just as much	102 (41.8)	49 (40.8)	53 (43.1)
I don't know	10 (4.1)	9 (7.5)	1 (0.8)

[a] Customers could specify multiple places therefore the total percentages per place can be more than 100.
[b] Values are medians [IQRs] (25th, 75th percentile).
[c] Values are means (SDs).

Taking into account subgroups that might respond differently to nudging strategies, we considered the use of a grocery list and the number of days for which groceries were purchased as potential effect modifiers. We did this because it is known from the literature that impulsivity plays a significant role in food choices (Nederkoorn, 2014; Nederkoorn, Guerrieri, Havermans, Roefs, & Jansen, 2009), which could therefore lead to different effects of nudging strategies on foods purchased. For example, it can be expected that customers who use a grocery list make other kinds of food purchases (e.g. more planned) compared to customers who do not use a list (e.g. more unplanned). The variable related to the number of days for which groceries were purchased was dichotomized, comparing customers who purchased groceries for less than three days to customers who purchased groceries for three days or more.

Table 3
The number and percentages of customers divided into tertiles of purchased vegetables (in grams and items) per shopping trolley for the total study period and for the control and intervention days separately (n = 244).

	Total study period *n* (%)	Control days *n* (%)	Intervention days *n* (%)
Tertiles of purchased items of vegetables			
Low: 0–1 items	72 (29.5)	42 (34.7)	30 (24.4)
Intermediate: 2–3 items	72 (29.5)	34 (28.1)	38 (30.9)
High: ≥ 4 items	100 (41)	45 (37.2)	55 (44.7)
Tertiles of purchased grams of vegetables			
Low: 0–480 g	78 (32.0)	47 (38.8)	31 (25.2)
Intermediate: 481–1570 g	84 (34.4)	37 (30.6)	47 (38.2)
High: ≥1571 g	82 (33.6)	37 (30.6)	45 (36.6)

n = number.
% = percentage.

A sensitivity analysis was also conducted to investigate whether customers who noticed the green inlay on the intervention days differed from those who did not in the association between the condition and the vegetables purchased for the number of grams and items separately. To investigate the association between the condition and vegetables purchased (in grams and items) we used two models: a crude model and one model adjusted for sex, age, highest level of education obtained and the number of people for whom groceries were purchased. The ORs represent the relative odds that customers were in a higher tertile of purchasing vegetables (grams or items) compared to the control days. A two-sided P value of < 0.05 was considered to be statistically significant. Statistical analyses were performed using the statistical software package IBM SPSS Statistics for Windows version 25.0.

3. Results

3.1. Participant characteristics and grocery purchase behaviour

Table 1 shows the baseline characteristics of the 244 customers who were included in our study. The intervention days comprised 123 customers and the control days 121. There were more women (61.1%) than men, all customers were 18 years or older and there was an equal percentage of younger adults (51.2%) and older adults (47.1%). With regard to education level, most customers had a medium (28.7%) or high (47.5%) education level. Customers purchased groceries for an average of 3.62 days (SD: 2.20) and an average of 2.77 people (SD: 1.43). Slightly more than half of the customers (54.1%) used a grocery list and more than two thirds of the customers (69.3%) usually purchased vegetables in the participating supermarket. Almost 45% of the customers thought they had purchased fewer vegetables than usual (44.7%) and nearly 42% thought they had purchased just as many vegetables as usual (see compared to those purchased usually (41.8%) (see Table 2). Of the customers on the intervention days, almost three quarters noticed the green inlay in their shopping trolley (73.3%). Other customers had noticed what they thought was a new shopping trolley (17.1%) or something else (9.5%) (data not shown).

3.2. Vegetables purchased

The medians for the number of grams and items of vegetables purchased were higher on the intervention days (median grams: 1120, IQR: 1, 7161; median items: 3.00, IQR: 0, 17) compared to the control days (median grams: 900, IQR: 1, 6785; median items: 2.00, IQR: 1, 15) (see Table 3). Customers on the intervention days were in a higher tertile for grams of vegetables purchased compared to the customers on the control days (OR: 1.66, 95% CI: 1.03–2.69, p = 0.03; see Table 4). Moreover, of the customers on the intervention days, those who

Table 4
Odds ratios (OR's) and 95% confidence intervals (CIs) for the association between condition (intervention vs. control days) and the tertiles of purchased vegetables (in grams and items) per shopping trolley (n = 244).

	Model 1 OR[a] + 95% CI	Model 2 OR[a] + 95% CI
Purchased items of vegetables		
Intervention days	1.48 (0.93–2.35)	1.51 (0.93–2.45)
Control days	1.00	1.00
Purchased grams of vegetables		
Intervention days	1.56 (0.98–2.49)	1.66 (1.03–2.69)*
Control days	1.00	1.00

P < 0.05.
Model 1: crude model.
Model 2: model adjusted for sex, age, education level and the number of persons for which groceries were purchased.
n = number.
[a] The estimates represent the relative odds that customers were in a higher tertile for purchasing vegetables (grams or items) compared to the control days.

purchased groceries for less than three days (OR: 3.24, 95% CI: 1.43–7.35, p = 0.003) were in a higher tertile for grams of vegetables purchased compared to the control days (see Table 5). However, the use of a grocery list did not lead to differences in vegetables purchased. Finally, the intervention customers who noticed the green inlay were in a higher tertile for items of vegetables purchased compared to the control days (OR: 1.86, 95% CI: 1.06–3.25, p = 0.02). We observed no further statistically significantly differences in vegetables purchased.

4. Discussion

This study showed that a green inlay in shopping trolleys with social norm messages about vegetable purchases of other customers and a designated place for vegetables in the trolley led to a statistically significant increase in *grams* of vegetables purchased, specifically in customers who purchased groceries for less than three days. Although we did not find an effect of the trolley inlays on the number of vegetable *items* purchased in the overall sample, subgroup analyses showed that it was apparent that customers who noticed the inlay purchased statistically significantly more vegetable *items* than customers during the control days. The use of a grocery list did not lead to differences in vegetables purchased (grams/items) during the intervention compared to the control days. The results of this study suggest that social norm nudges related to vegetable purchases in shopping trolleys have a potential positive effect on vegetable purchases (grams/items) by supermarket customers in a deprived urban area.

The results of the current study support the findings of two previous studies (Payne et al., 2015; Wansink et al., 2017), which formed the basis of our research. These two studies showed that nudging in shopping trolleys increased the total amount of money spent on fruit and vegetables in supermarkets. However, it is not clear whether the customers in the previous studies purchased fruit and vegetables that were more expensive or whether they purchased a greater amount of fruit and vegetables. To the best of our knowledge, this is the first study that investigated the effect of nudging strategies in supermarket shopping trolleys by means of the number of grams and items of vegetables purchased, which seems a more accurate and relevant measure of actual vegetable intake than money spent. Despite the different outcome measures used in the three studies, the findings suggest that a combination of strategies in supermarket shopping trolleys, can lead to increased vegetable sales and have the potential to stimulate vegetable purchases among supermarket customers in a deprived urban area.

One interesting finding was that, of the customers with a green inlay in their shopping trolley, those who purchased groceries for less than three days, purchased more grams of vegetables than those who purchased groceries for more than three days. This might be explained by the assumption that customers who purchased groceries for less than three days make more unplanned and less deliberate purchases, compared to those shopping for a longer period of time (e.g. habitual purchases, weekly groceries). As a result, the food purchases of those customers may be more likely to be impulsive or influenced by external factors and, therefore, they might be more sensitive to the social norm nudges that were used in this study. This assumption is in line with results from a previous study which indicated that people who make more unplanned food purchases may be more sensitive to promotions and marketing strategies, resulting in different food purchases compared to people who make more planned food purchases (Nederkoorn, 2014).

However, another explanation of the insignificant effect for customers on the intervention days who purchased groceries for three days or more may be related to the statistical analyses that we used in this study. We investigated the relative chance that a customer purchased more grams of vegetables than those in the control group. We did this by means of three categories (low, mid, high) of grams of vegetables purchased, as the data was not normally distributed. It might be the case that the customers who purchased groceries for three days or more already purchase a higher number of grams of vegetables, and therefore they may already be in the highest purchase group. As a result, any potential effect of the nudge on the customers who were already in the highest purchase group remained undetectable in this study. It is therefore recommended that future studies use a larger sample and investigate the effect of social norm nudges in shopping trolleys among different types of customers, establishing differences in sensitivity to

Table 5
Odds ratios (OR's) and 95% confidence intervals (CIs) for the association between condition (control days vs. intervention days) and tertiles of purchased vegetables (in grams and items) per shopping trolley divided into customers who used or not used a grocery list, and for customers who purchased groceries for less or more than three days (n = 244).

	Customers who used a grocery list		Customers who did not use a grocery list		Customers who purchased groceries for less than three days		Customers who purchased groceries for three days or more	
	Purchased items of vegetables	Purchased grams of vegetables	Purchased items of vegetables	Purchased grams of vegetables	Purchased items of vegetables	Purchased grams of vegetables	Purchased items of vegetables	Purchased grams of vegetables
Model 1 OR[a] 95% CI								
Intervention days	1.69 (0.89–3.21)	1.76 (0.93–3.32)	1.27 (0.64–2.51)	1.36 (0.69–2.71)	1.86 (0.90–3.87)	2.84 (1.33–6.04)*	1.66 (0.88–3.15)	1.34 (0.72–2.49)
Control days	1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Model 2 OR[a] 95% CI								
Intervention days	1.14 (0.57–2.31)	1.86 (0.92–3.75)	1.61 (0.80–3.25)	1.27 (0.63–2.57)	1.95 (0.88–4.29)	3.24 (1.43–7.35)*	1.62 (0.84–3.13)	1.34 (0.71–2.54)
Control days	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

*p = < 0.05.
Model 1: crude model.
Model 2: model adjusted for sex, age, education level and the number of persons for which groceries were purchased.
[a] The estimates represent the relative odds that customers where in a higher tertile for purchasing vegetables (grams or items) compared to the control days.

social norm nudges.

The insignificant effects on vegetable items purchased in the total study sample might be explained by the fact that both a single vegetable as well as a multi-pack were counted as 'one item'. The shift from a single item to a multi-pack could only be detected in the grams of vegetables purchased. However, we cannot explain why customers who noticed the green inlay in their trolley purchased statistically significantly more vegetable items but not grams than the customers from the control days. We know little about how much attention to and awareness of nudges are needed for them to be effective, and this has not been extensively and systematically tested thus far (Marchiori, Adriaanse, & De Ridder, 2017).

Future research should establish the most optimal circumstances required to maximize the effect of social norm nudges in shopping trolleys to promote vegetable purchases in supermarkets. This seems of specific importance in a supermarket environment where people have to make food choices with limited cognitive resources, often while under (time) pressure (e.g. hungry, tired, in a hurry) (Furst, Connors, Bisogni, Sobal, & Falk, 1996).

This study contributes to the literature by combining social norm nudges and showing that they can promote vegetable purchases in a supermarket in a deprived urban area. Moreover, this study used supermarket cash receipts to measure food purchases, resulting in data that are objective and unaffected by recall bias and overrepresentation of occasional purchases or social desirability (Tin, Mhurchu, & Bullen, 2007). Furthermore, we used the number of grams and items of vegetables purchased as outcome measures, which indicates the impact of nudging on vegetable intake more precisely than, for example, the amount of money spent on vegetables (Bucher et al., 2016).

This study also has some limitations, such as the low response rate due to customers being recruited after having paid, with many pointing out that they had no time. However, by recruiting customers after they had paid, we did not influence their purchase behaviour. As this study was conducted in a real-life setting, it is likely that there were participants who participated more than once, and therefore we cannot exclude the possibility that this might have led to an under- or overestimation of the effect of the intervention on vegetables purchased. However, if customers mentioned that they had already participated in the study, they were excluded, reducing the likelihood that they participated more than once. Another limitation was that only 12.7% of the customers had a low education level. Therefore, we cannot generalize the results to supermarket customers from low-SEP groups, although disparities in study participation have been observed in previous supermarket studies (Mhurchu et al., 2009; Olstad et al., 2016; Waterlander, de Boer, Schuit, Seidell, & Steenhuis, 2013). Future studies could perhaps resolve this issue by involving key members of the target communities in the recruitment of participants, for example. Future studies could also use sales data at store level and a tracking system such as a personal card that could be scanned at the checkout to link customers to their purchases. Furthermore, this study was also limited to one supermarket and was conducted over a short period of time. Future research should investigate the effects of social norm nudges in shopping trolleys in a larger sample of supermarkets over a longer period of time.

Although the impact on vegetable purchases found in this study seems relatively small on an individual level, it does show the potential of an easy, subtle and cheap-to-implement health intervention in supermarkets, which could contribute to an increase in vegetable purchases on the population level. Health interventions targeting an entire population are usually relatively cost-effective and they benefit many people simultaneously, but they offer little health advantages to each participating individual (Rose, 1981, 2001). Nevertheless, a single supermarket intervention, such as the social norm nudges in this study, might itself be seen as part of a broader strategy including multiple approaches to stimulating vegetable (and other healthier) purchases in supermarkets. This has also been confirmed in previous reviews that have demonstrated that when more effective strategies are combined in health interventions, they are more successful overall in positively changing food purchase behaviour in supermarkets (Adam & Jensen, 2016; Escaron et al., 2013).

5. Conclusion

This quasi-experimental study showed that a green inlay in shopping trolleys that communicated a social norm on vegetable purchases and indicated a specific place to put vegetables was effective in increasing vegetable purchases among customers of a supermarket in a deprived urban area. The intervention appeared especially beneficial for customers who purchased groceries for one or two days and those who noticed the social norm message in the trolley. More research on the short and long-term impacts of social norm nudges in shopping trolleys is required, not only as single interventions but also as part of a more complex strategy to increase supermarket customer vegetable purchases and the daily intake of vegetables.

Authors' contribution

MH contributed to and coordinated the design of the study, was responsible for the execution of the intervention, collected the data, carried out the data analysis and wrote the manuscript. CD and JS developed the design of the study, interpreted the results and critically reviewed the manuscript. MP collected the data, interpreted the results and critically reviewed the manuscript. EY contributed to the development of the intervention, collected the data and critically reviewed the manuscript. All authors played a role in data interpretation and writing of the manuscript and approved the final version of the manuscript.

Availability of data and materials

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

Declaration of competing interest

The authors declare that they have no financial relationships relevant to this article. The supermarket chain collaborated in the organization of the study but did not have any role in the analyses of this study. The supermarket chain signed a contract and agreed that the results of this research would be published regardless of the outcome.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2020.104655.

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